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NF and organic solvents:How pure can you get?

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In many downstream processing steps very clean organic solvents have to be used. The consumption of these solvents contributes considerably to the costs of the operation. In would be very favorable if such solvents could be re-used. In-line recovery and re-use would be even more interesting. However, the current possibilities are very limited, specific and hence difficult to use as a generic technology.

In theory, membrane filtration could be very attractive to facilitate in-process recovery. For large processes but also for typical small operations as are encountered in extraction plants (special vegetable oils, cosmetics from natural origin etc.). These are typically used as small batch purifications and a low temperature separation process gives higher quality products and permit small operations to be effective and economically viable.

Therefore, it is proposed to setup a platform technology for solvent recovery that is versatile to be used in multiple processes. Membrane technology could be an important role in such a technology. It can be couple to e.g. short-path distillation or adsorptive techniques. Based on two types of solvents -alcohols and aromatics- the possibilities of the technology will be explored. The two solvents mentioned present realistic representative test cases for other solvents.

How far the techniques have to be combined depends on the separation power of them, and from these that of the membrane is realistically the most unknown. In water it is generally accepted that membranes should not be used for full recovery of the feed. Nevertheless, we have seen in the last years that recovery of water have increased very much. This is realized by optimizing the flow conditions of the elements (and membranes), better antifouling measures and better cleaning regimes but also by optimizing the process design.

We have focused on realizing the maximum performance of the membranes and try to come up with process designs that benefits from that.

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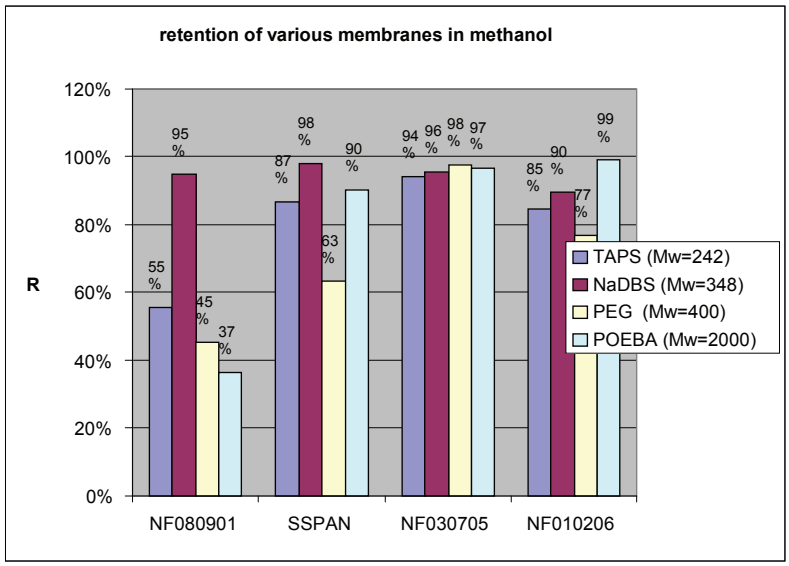

Figure 1. Retention of some SolSep membranes in methanol.

An example is the recovery of methanol. We have measured retention of various membranes of specific components with molar masses between 242 Da and 2000 Da.

In figure 1 it is shown that a relatively high retention (94+%) of foulant molecules can be realized. Of course, throughput of the membrane is important as well. For some applications retentions of 90+% are not high enough. Instead of leaving the membrane concept we have evaluated combinations of membranes as well as combination with (short path) distillation.

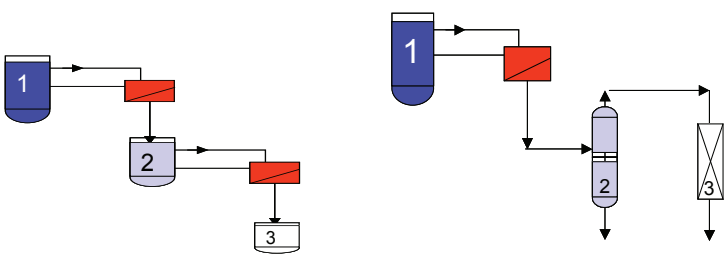

Figure 2. Left hand side: multipasses through (separate) membranes. Right hand side membrane in combination with evaporation and adsorption.

Of course, the total recovery of the whole system is determined by the recoveries of the individual unit operations. But as these are also influenced by e.g. loading, a proper order in the cascade can have a main impact on total costs.

Keywords: Nanofiltration, Organic solvent, Process, solvent recovery